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Acceleration and Deceleration Control Design of Step Motor Based on TMS320F240

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Abstract

This paper describes the use of DSP implementation of a smart controller TMS320C240 stepper motor acceleration and deceleration control in Intelligent spherical camera pan and tilt institutions, discusses using exponential curve to achieve the method of stepper motor acceleration and deceleration, the practice shows that the system is reliable, the control accurate, and to achieve the desired design effect.

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Keywords: TMS320F240; stepper motor; exponential curve; acceleration and deceleration control

1. Introduction

The background of the system design is based on the intelligent security monitoring camera pan and tilt motion mechanism ball control. Horizontal and vertical head movement required to achieve the object and scope of the camera monitoring the changes, and the stepper motor is the power source for driven dome camera pan and tilt for horizontal and vertical movement. In order to achieve the exact location of the camera, while ensuring the continuity of the image in the camera rotation, the need for the stepper motor speed control.

Stepper motor is a kind electromechanical actuator of electrical pulse signal transformed into a corresponding angular displacement or linear displacement. Stepper motor drive actuator head to move from one location to another location, generally through acceleration, constant speed and deceleration. If the speed starts to rise again to set the pace, start by activating the frequency exceeding the limit frequency of the stepper motor to step phenomenon occurs, resulting not start correctly. If you suddenly stop to the end, due to inertia, the motor will step overshoot phenomenon will result in reduced position

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accuracy. Therefore, the rational design of the stepper motor acceleration and deceleration curves and stable operation of the system is very important.

2. Design of acceleration and deceleration curves

Stepper motor acceleration and deceleration curves are commonly used: uniform acceleration and deceleration curve, exponential curve acceleration and deceleration, S-type acceleration and deceleration curves shown in Fig 1, in the figure f for the start frequency. Curve for uniform acceleration and deceleration control system processing speed is slow and speed up the process less demanding on the occasion; index and S-curve acceleration control system for fast processing speed and acceleration requirements of high places.

Fig.1. Acceleration and Deceleration Operation Curve

Through the above comparison of acceleration and deceleration control method, taking into account the system requirements of pan speed, moving time, and ease of programming to achieve a combination of factors, the final system selected exponential curve to achieve the acceleration and deceleration control of the stepper motor acceleration and deceleration control.

2.1. Stepper Motor exponential curve acceleration and deceleration control method

Based on the stepping motor control system TMS320F240 basic working principle is: DSP control commands issued through the buffer to A3979, to control A3979 level of the corresponding port on the stepper motor can operate to control the direction and speed, that is, to a pulse stepper motor rotation step. TMS320F240 also known as DSP controller, TI, specifically for the motor, inverter, robots, CNC machine tools and control and design. Allegro A3979 is the company in recent years launched a micro-step control with stepper motor drive, built-in decoder. Fig 2 is based on TMS320F240 the stepping motor control system block diagram.

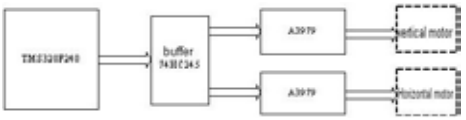

Fig.2. Block Diagram of Stepper Motor Control System

Exponential curve stepper motor acceleration and deceleration control design thinking is: when the stepper motor to the right start with a load frequency of start time by changing the timing of the timer to control the stepper motor operating frequency, in accordance with the characteristics of the index curve for the system down frequency, in the intermediate stages of operation at maximum operating frequency of uniform operation, and ultimately to achieve fast and accurate positioning.

Fig 3 is similar exponential speed curve. The figure shows, the discrete speed is not been on the rise, but the level per level to be maintained for some time, so the actual speed ladder-like trajectory. Stepper motor speed level at each step to keep the number of time instead of using the system will be horizontal speed of the motor into 18 discrete levels, the vertical pitch of the motor speed is discretized into six grades (grades only take the horizontal velocity the first six). Prior to programming, done a lot of

experiments, in the case of head with a load, according to an exponential curve of the discrete method, combined with the system features used by the motor for each speed grade and the corresponding number of steps to one level of joint test the final grades obtained for each speed acceleration and deceleration curves corresponding to the data (the frequency of the stepper motor and the need to take the required number of steps), and speed grades corresponding to each stepper motor step frequency values and the corresponding number system into a table (see Table 1), facilitate the application of the stepper motor acceleration and deceleration control. Acceleration curve is given here only the method of handling, processing and acceleration deceleration curves approach the same curve, but the process is to accelerate the reverse process.

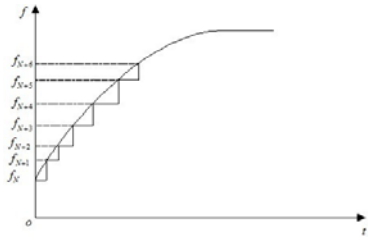

Fig.3. Exponential Acceleration Discrete Curve

According to Table 1 data plotted in Fig 4 stepper motor acceleration curve, after a comparison with the ideal exponential curve was found between the two similar. Platform in the head while debugging, observed during the motor acceleration and deceleration without jitter, stall and overshoot phenomena. PTZ preset point lead PTZ camera horizontal and vertical positioning accuracy, image clarity, stability, and all continuous phenomenon.

Table1. Exponential acceleration curve discrete data sheet

Speed level	Frequency /Hz	Steps per level	Speed level	Frequency /Hz	Steps per level
1	50	35	10	3224	400
2	165	45	11	3502	500
3	444	55	12	3780	510
4	722	80	13	4058	550
5	1000	160	14	4336	610
6	1556	200	15	4614	625
7	2112	250	16	4892	640
8	2560	310	17	5170	650
9	2946	370	18	5448	660

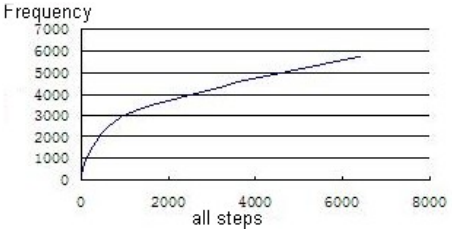

Fig.4. Stepper Motor Acceleration Curve

2.2. Software Design

According to the above control method, we design an exponential curve acceleration and deceleration control procedures. Acceleration and deceleration phase of the motor frequency is changing, you can change the initial value of timer TMS320F240 to achieve. This frequency corresponds to each level and the corresponding timer initial steps is stored in a table so that SCM can look-up table to control the stepper motor to make it in accordance with the exponential curve to the rising and falling speed. As mentioned earlier is to accelerate the slow process of the inverse process is given here only to accelerate the stepper motor control subroutine flow chart shown in Fig 5.

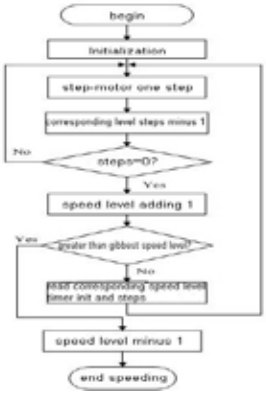

Fig.5. Subroutine Flow Chart of Stepper Motor Acceleration Control

3. Conclusion

Stepper motor acceleration and deceleration control methods are more, this paper based intelligent dome characteristics of control systems, using the exponential curve acceleration and deceleration control of the stepper motor. Proven that this system is the software programming is simple, low cost, simple and effective control of stepper motor speed and so on.

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